Space Weather Technical Forecast

Issued on Tuesday 4 March 2025 at 12:57 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: chance of M-class flares (R1-R2; Minor-Moderate radio blackouts) throughout. Chance of G1/G2 late Day 1 into Day 2.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity measured at GOES16 and 18 has been Low, with a peak flare of C3.4 at 04/0052UTC from the AR4011 presently located in the southeast quadrant.

The solar disc features eight sunspot regions. Most notably being AR4012 which is the largest and most complex, located on the southeast quadrant. The second most notable region is AR4006 in the southwest quadrant.

No Earth-directed Coronal Mass Ejections (CMEs) were identified in available coronagraph imagery.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE at L1, are easing after previous fast wind enhancement.

Solar wind speeds as measured by ACE at L1, have been Slightly Elevated from 450 to 500 km/s. The solar wind density was below average. The Interplanetary Magnetic Field was mostly Weak with a peak of 8nT, while the north-south component favoured a positive direction, ranging from +8/-5nT. The phi angle was largely positive (away from the Sun).

The net result of the above solar wind measures was Quiet geomagnetic activity.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at Background.

High energy electron flux saw a rise in its diurnal oscillation, reaching High of 1130pfu at 03/1635TC. The 24-hour fluence was below the Active threshold (1e8 integrated pfu), on a level trend, recording 4.96e7 integrated pfu at 04/0000TC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate levels expected, with a Chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: A CME from the 01/1730UTC filament eruption from the southeast disc may affect Earth as a glancing blow late on day 1 (4 March). This is the only CME in

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the forecast. Slightly Elevated winds are expected to continue declining towards Background prior to any CME arrival.

Geomagnetic activity is expected to be mainly Quiet with a chance of G1 to G2 from any CME arrival.

Energetic Particles / Solar Radiation: High energy proton flux should remain at Background levels.

High energy electron flux has seen diurnal rises into the high levels in the past 24 hours, with a declining trend now expected. The associated 24 hour fluence is expected to remain below Active.

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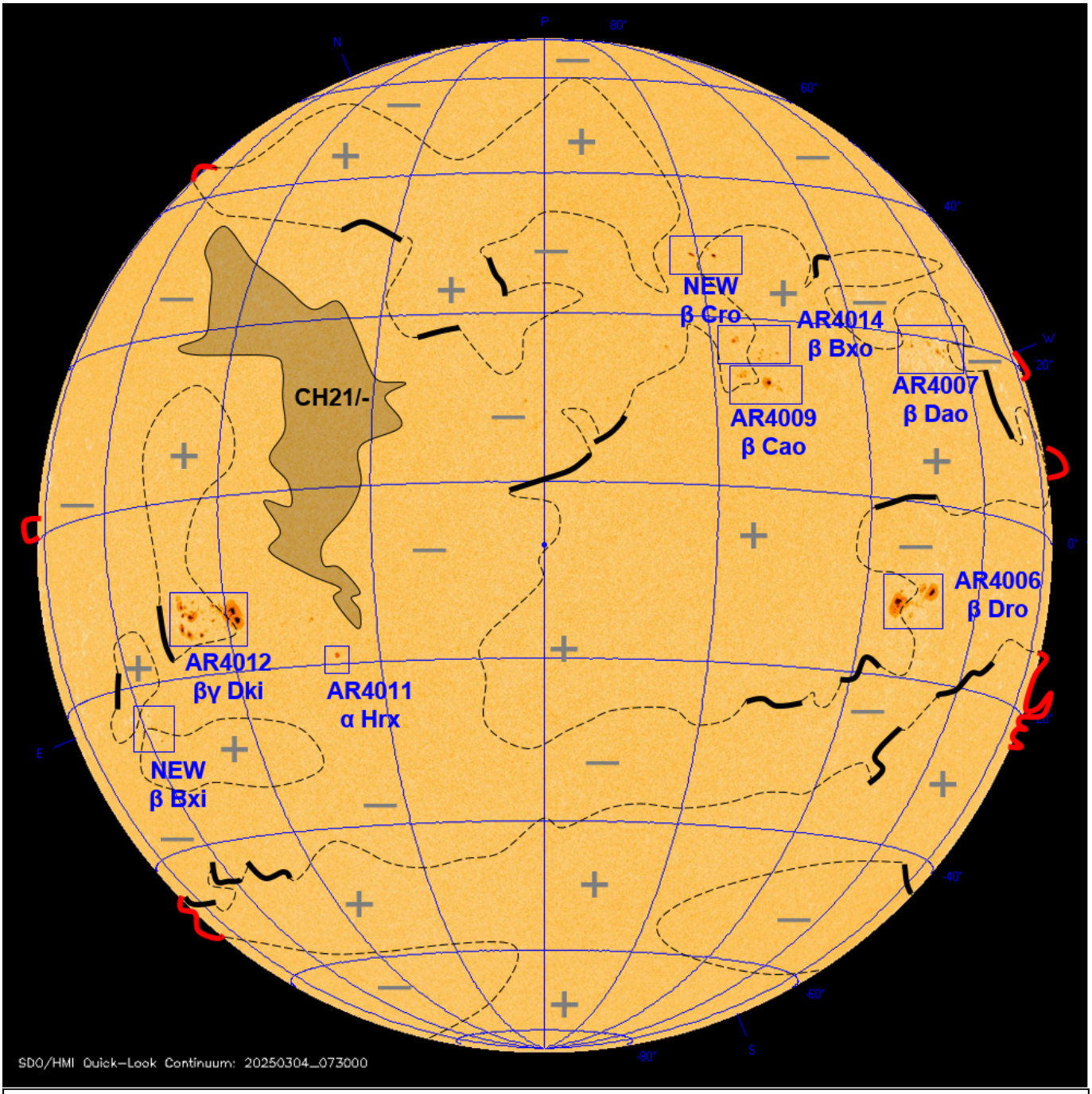
Figure 1: Solar Synoptic Map - 04/0730 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

A CME from the 01/1730UTC filament eruption from the southeast disc may affect Earth as a glancing blow later on Day 1 (4 March). It appears the majority of the ejecta is south and east of the Sun-Earth line, and is likely to miss Earth. This is the only CME in the forecast.

In addition to the above, the High Speed Stream (HSS) influence from previous CH enhancements is expected to continue to wane, with currently Slightly Elevated winds declining towards Background in the coming day or two. No further coronal holes are expected to feature in the forecast period.

Geomagnetic activity is Likely to be Quiet until later on Tuesday 04 March, whereupon the aforementioned CME brings a Chance of G1 (Kp5) to end the UTC day and on through midweek UTC. There is a Slight Chance this may reach G2 (Kp6) given the nature of the eruption, should it arrive early in the evening with southward polarity. Because of the forecast arrival time coming late in the 24-hour UTC day, much of the G1 risk is actually post-dated into Wednesday 05 March in the magnetic cloud, although this may not fully develop due to the glancing incidence expected.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	40	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
02/0154UTC	Partial?	Filament eruption	SE quadrant	550	Late UTC day Tuesday 04 March, around 04/1900UTC.	Potentially protracted but marginal effects on passage given glancing incidence.

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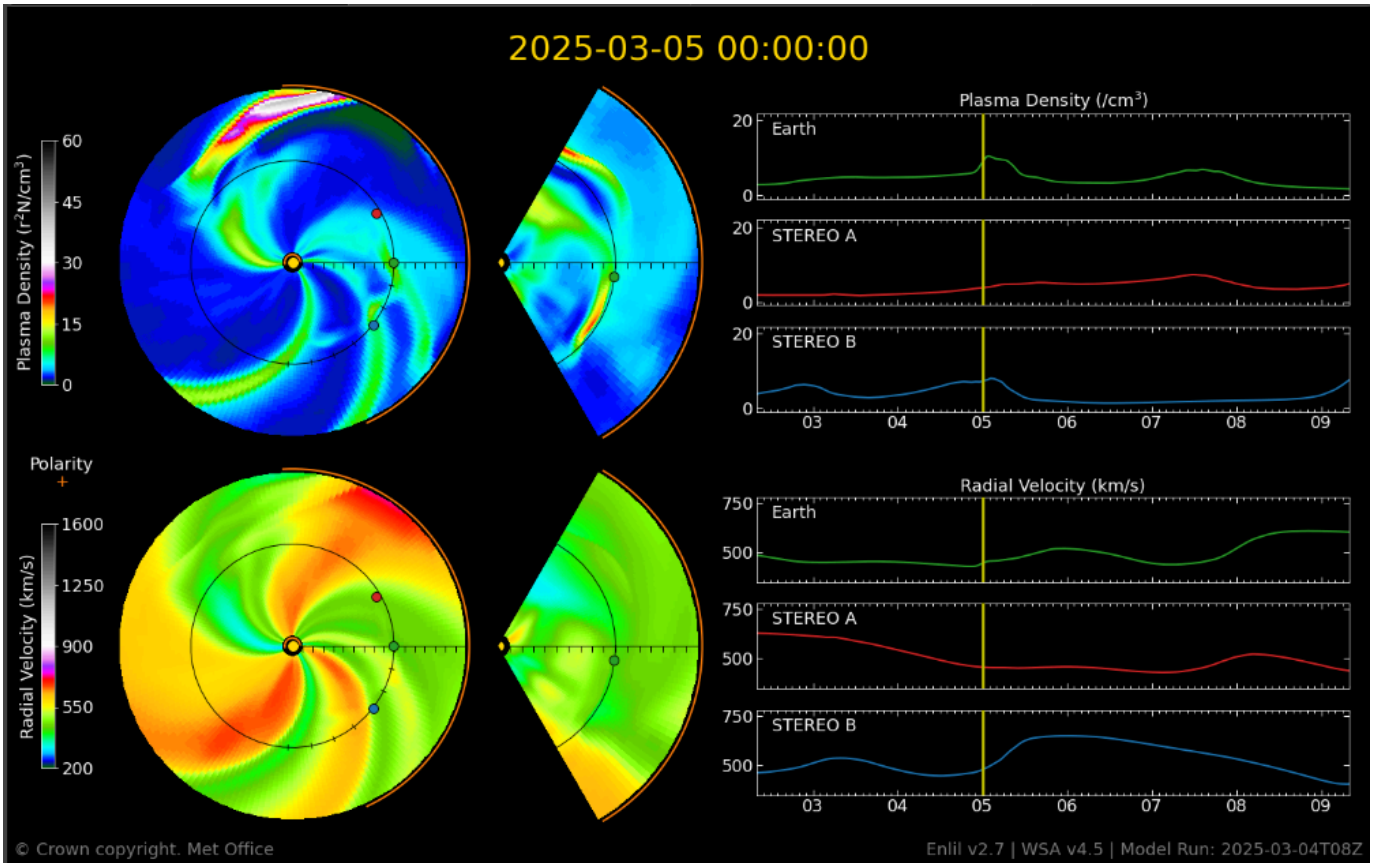
Figure 2: MOSWOC ENLIL showing potential CME arrival



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Radio Blackouts - X-Ray Flares

Eight sunspot regions cover the visible solar disc with two unnumbered regions. In terms of magnetic complexity the most notable is AR4012 which is the largest region currently on the disc. AR4007 is the second largest region and is a relatively simple bi-polar group. AR4009 lies just south of AR4014 and both regions are bi-polar and have shown signs of waning in recent hours. AR4006 and AR4011 present as small and simple spots on the disc, with some decline shown, particularly with AR4011 which is unipolar. One of the NEW regions in the northwest has now been numbered as AR4015 but remains simple.

Solar activity carries an increasing Chance of M-class flares.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 (M Class)**	No	40	50	50	50
Very Active	**R3-R5 (X Class)**	No	1	1	1	1

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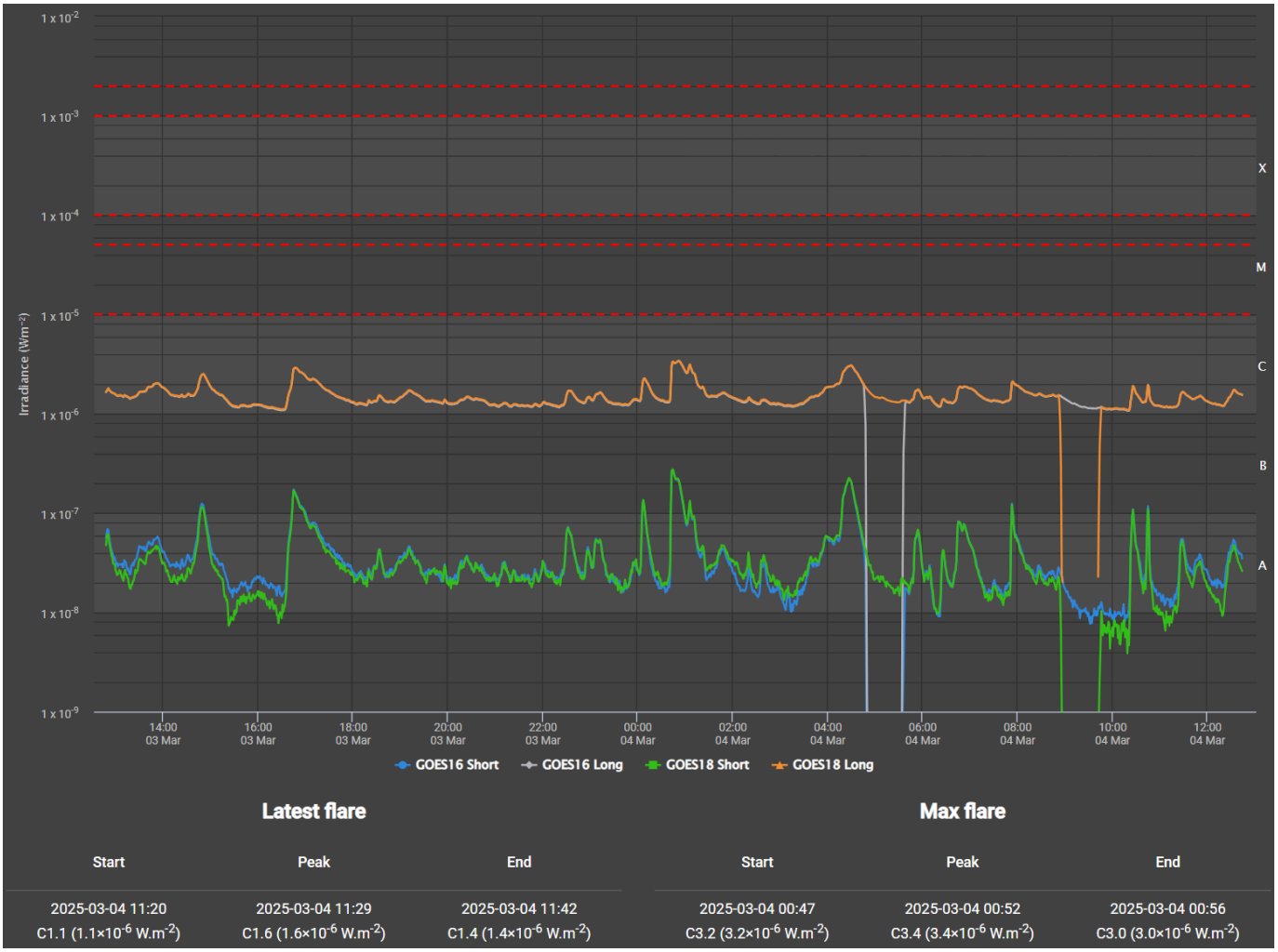
Figure 3: GOES16/18 X-ray flares



Latest flare

Start	Peak	End
2025-03-04 11:20 C1.1 (1.1×10^{-6} W.m^{-2})	2025-03-04 11:29 C1.6 (1.6×10^{-6} W.m^{-2})	2025-03-04 11:42 C1.4 (1.4×10^{-6} W.m^{-2})

Max flare

Start	Peak	End
2025-03-04 00:47 C3.2 (3.2×10^{-6} W.m^{-2})	2025-03-04 00:52 C3.4 (3.4×10^{-6} W.m^{-2})	2025-03-04 00:56 C3.0 (3.0×10^{-6} W.m^{-2})

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Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux is at Background, and expected to remain at this level. There is a Slight Chance of enhancement to S1 given any significant eruption from the sunspot regions currently on the Earth-facing disc, very gradually increasing through midweek UTC as some of the more complex regions reach better-connecting parts of the disc (i.e. the westernmost third).

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

The high energy electron flux (>2MeV), as observed at GOES16, has been mostly Moderate but saw a short period of High flux in the past UTC day. This was due to the recent charging of the outer Van Allen Belt from the fast wind enhancement from CH18/+ and/or CH19/+. Moderate flux being maintained at GEO becomes far less certain through midweek UTC as a result of possible influence of the 01/1730UTC filament CME, which may cause electron redistribution and falls of flux at GEO. No further enhancements are forecast.

The associated 24-hour fluence is now expected to continue declining and stay below Active as indicated by MOSWOC REFM.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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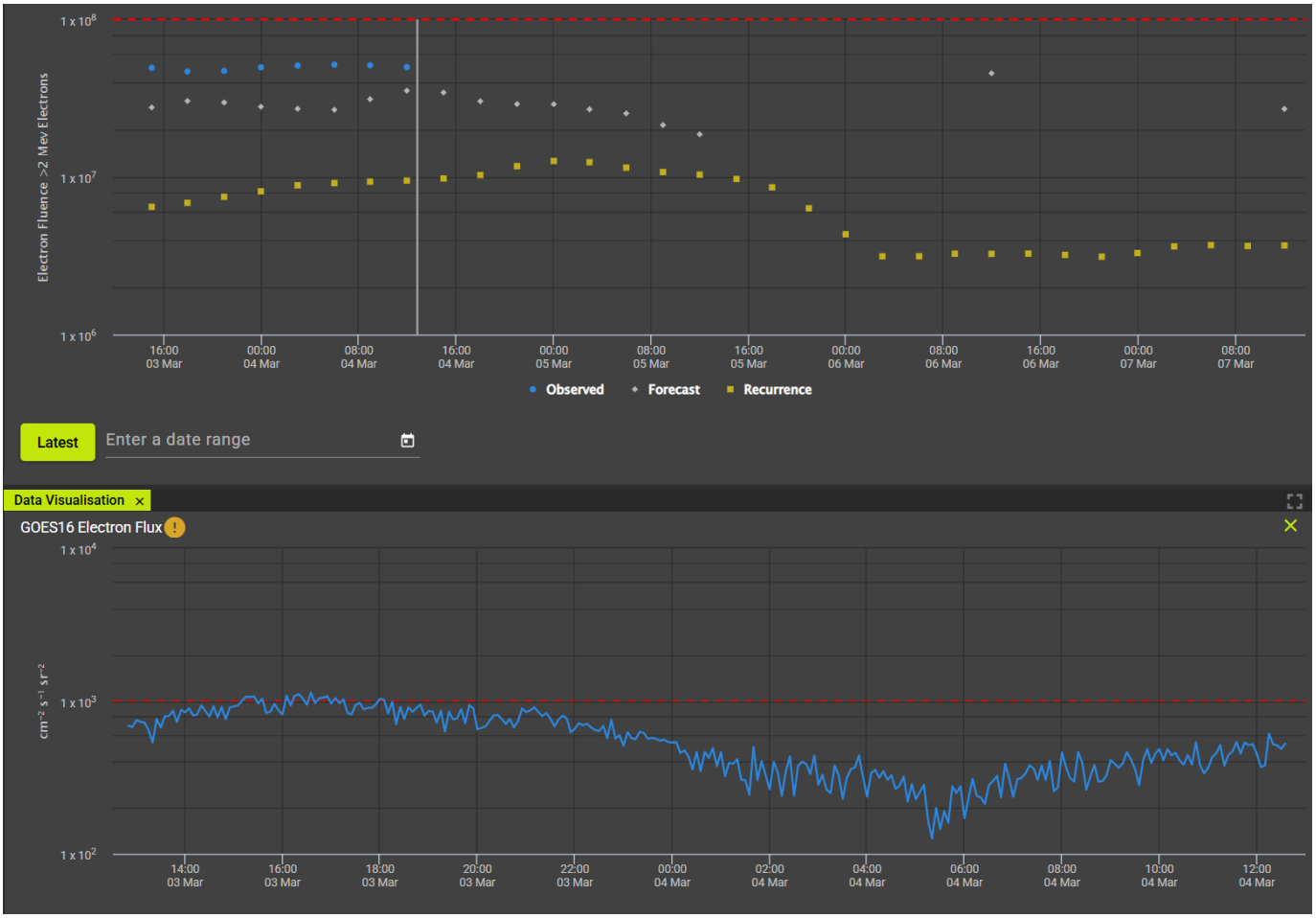
Figure 4: REFM Electron fluence and GOES16 Electron Flux



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